

Preliminary results on assimilation of AIRS radiances and retrievals in the Rapid Refresh

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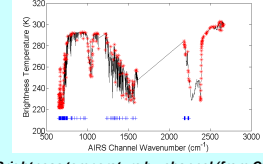
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BACKGROUND

Evaluate impact of AIRS data assimilation on the Rapid Refresh (RR) mesoscale prediction system (AIRS not yet used in RR)

Atmospheric Infrared Sounder (AIRS) data can provide high-resolution temperature and water vapor information

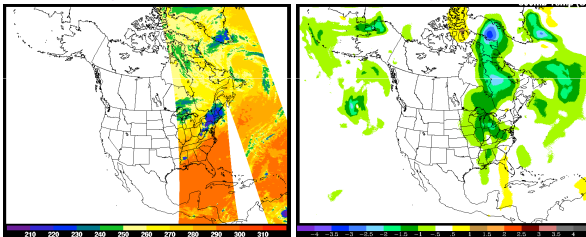


- 2002 launch of NASA EOS polar-orbiting Aqua platform
- Twice daily global coverage, 13.5 km res.
- 2378 spectral channels (3.7-15.4 μm)
- 120 (blue plus) / 281 (red star) channels in GSI
- Single Field of View (SFOV) soundings (T, Q) from CIMSS physical retrieval algorithm

Brightness temperature by channel (from CRTM)

Radiance Assimilation Results

Analysis Impact – 0600 UTC 8 May 2010



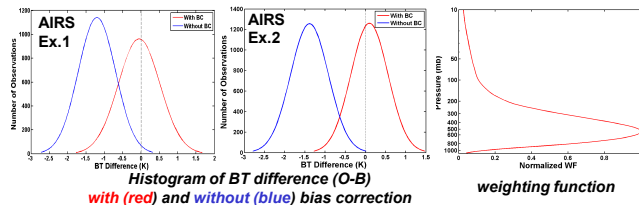
AIRS brightness temperature for channel 791

500 hPa temperature analysis difference (A-A) between AIRS radiance and CNTL assimilation cycles

Experiments

- Control run (CNTL, conventional data only)
- AIRS experiment one (AIRS Ex. 1)
 - CNTL + AIRS radiance data (60 km thinning in GSI)
 - mass bias coefficients cycled starting from zero
- AIRS experiment two (AIRS Ex. 2)
 - The same as Ex. 1 except for using the bias coefficients from the last cycle of Ex. 1 as the initial coefficients

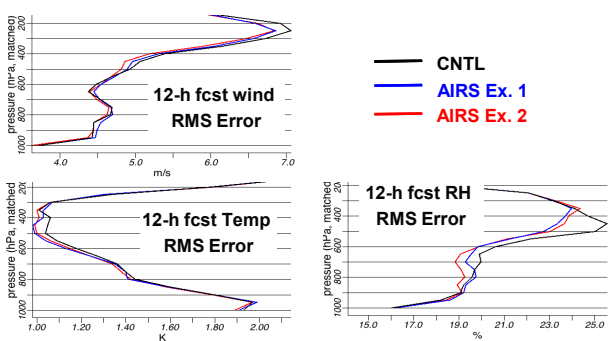
Sample bias correction for AIRS channel 221 (CO2 channel)



Histogram of BT difference (O-B) with (red) and without (blue) bias correction

weighting function

Profile of 12-h fcst RMS (against raobs)



SUMMARY AND FUTURE WORK

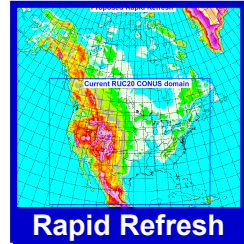
Preliminary result: AIRS data has slight positive impact for short-term predictions in Rapid Refresh, especially for use of radiances

Plans:

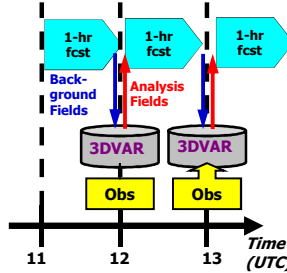
- Continue evaluation of impact of AIRS radiance and retrieval data
- 2-week warm-up period is needed for stabilization of bias coefficients
- Cloud contamination investigation
- 1-h cycle run and/or with partial cycle run
- More cases
- Operational use of AIRS data in RR

Rapid Refresh (RR)

- Hourly updated model/assim. cycle replacing RUC
- Implement at NCEP Sept 2011
- 13km domain covers all of North America and large oceanic regions with sparse data coverage
- RR uses GSI analysis and WRF ARW model



Rapid Refresh



Data types – counts/hr

Rawinsonde (12h)	150
NOAA profile	35
VAD winds	~130
PBL profilers / RASS	~25
Aircraft (V,T)	3500–10,000
TAMDAR	200–3000
METAR surface	2000–2500
Mesonet (T,Td)	~8000
Mesonet (V)	~4000
Buoy / ship	200–400
GOES cloud winds	4000–8000
METAR cloud/vis/wx	~1800
GOES cloud-top P,T	10 km res.
satellite radiance	~5,000
Radar reflectivity	1 km res.

Rawinsonde denial expt: compare with previous study

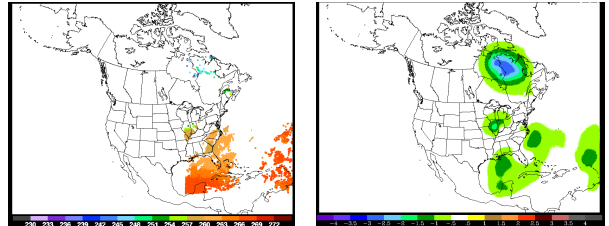
RMS error impact	Raob denial retro run	Benj. et al. MWR 2010
12-h fcst T	0.11 K	0.15 K
12-h fcst RH	1.11%	1.75%
12-h fcst wind	0.17 m/s	0.18 m/s

Experiment Design

- 9-day retrospective period (May 8-16, 2010)
- 3-h fully-cycled runs (real-time RR uses 1-h with partial cycle)
- Raob denial experiment results with RR roughly match those in previous study with RUC ✓

SFOV Retrieval Assimilation Results

Analysis Impact – 0600 UTC 8 May 2010

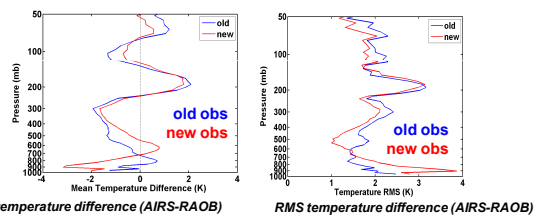


AIRS SFOV 500 hPa temperature

500 hPa temperature analysis difference (A-A) between SFOV and CNTL assimilation cycles

Evaluation of AIRS SFOV retrievals compared to raobs

Obtain matched profiles during 9-day retrospective period: must be within 3-h time window and 15 km horizontal distance



Mean temperature difference (AIRS-RAOB)

RMS temperature difference (AIRS-RAOB)

Experiments

- CNTL – Conventional obs + all available 1-h radiance (except AIRS radiance data)
- SFOV Ex. 1 – CNTL + old SFOV T data (60 km horiz. / 50 hPa vert. thinning, 400-800 hPa only)
- SFOV Ex. 2 – same as Ex. 1 except for using the new T data

Profile of 12-h fcst RMS (against raobs)

